

I claim the following:

1. Apparatus for removing malignant tissue from the colon wall while within the colon, comprising:

a. a longitudinally elongated operating capsule comprising:

5 i. an outer shell having a curved end at one longitudinal extremity thereof, comprising:

(1) an upper shell portion;

(2) a lower shell portion;

10 (3) hinge means connecting said upper and lower shell portions and being generally longitudinally aligned and positioned along said longitudinally elongated portion of said shell, facilitating opening of said shell by relative rotation between said shell portions about said hinge means;

15 (4) said shell portions when closed having respective facing lip portions spaced from one another;

20 (5) said lip portions extending around a portion of said curved end of said shell and along said longitudinally elongated portion of said capsule;

25 (6) anvil means resident in one of said facing lip portions, extending along the curved and longitudinally elongated portions thereof;

- 5
- 10
- 15
- 20
- 25
- (7) suturing staple means resident in said remaining lip portion, extending along the curved and longitudinally elongated lip portions facing said anvil means, for passing through any tissue positioned between respective lips and hence between said suturing staple means and said anvil means and curling back, respecting initial direction of suture staple movement perpendicularly to said lip, into said tissue positioned between said respective lips, away from said anvil means due to contact therewith, for securing said tissue together along a line between said suturing staple means and said anvil means;
- (8) suturing staple advancement and tissue cutting means movable along said lip portion having said suturing staples resident therewithin, for sequentially advancing said staples serially against said anvil means in said opposing lip portion when said shell portions are closed and thereby effectuating suturing staple securement of tissue between said lip housing said suturing staple means and said lip housing said anvil means;
- (9) a transition portion at one end of said shell adjoining said upper and lower shell portions,

for connecting said operating capsule to a flexible tubular member carrying cable for operating control of said capsule;

5 (10) means for opening said shell by effectuating relative rotation of said upper shell portion with respect to said lower shell portion, comprising:

(a) a threaded shaft rotatably mounted within said transition portion;

10 (b) a carrier threadedly engaging said shaft and moving axially therealong responsively to shaft rotation;

said carrier being pivotally connected to one of said shell portions for pivotally moving said shell portions about said hinge upon movement of said carrier axially along said shaft;

15 ii. means within said capsule operable responsively to operator manual input for gripping lumenal tissue proximate said undesired tissue and pulling said gripped tissue and said undesired tissue into a cutting zone within said capsule removed from an undisturbed position of said lumenal tissue;

20 b. said cable carrying flexible tubular member connecting said operating capsule to an operator control module and comprising:

- 5
- 10
- 15
- 20
- 25
- i. an outer cylindrical sheath;
- ii. a hollow inner cylindrical sheath within said outer sheath;
- iii. a plurality of conical disks between said inner and outer sheaths, each disk comprising:
- (1) a hollow central conical portion having an axial aperture at the center thereof, said inner sheath residing within said aperture;
- (2) an annular flange at the base of said conical portion;
- a convex conical exterior surface of said conical portion extending through said annular flange and fitting into the hollow central conical portion of an adjacent disk, in sliding complementary contact therewith;
- (a) said flange having a plurality of slots extending radially inwardly from the flange periphery;
- c. said operator control module comprising:
- i. knob means for facilitating capsule up/down, left/right and open/close motions;
- ii. trigger means for pulling on a first cable and thereby drawing said suturing staple advancement and tissue cutting means along said lip portion of said shell having said suturing staples resident therewithin and thereby advancing said staples

serially against said anvil means in said opposing lip portion when said shell portions are closed and effectuating suturing staple securement of tissue between said lip housing said suturing staple means and said lip housing said anvil means;

5

iii. helical spring means for biasing said trigger against movement in a direction to pull on said first cable;

10

d. said first cable having a first end wrapped around a pulley within said control module rotated by said trigger, with a second end connecting to said staple advancement and tissue cutting means;

15

e. a second cable wrapping about said pulley within said control module associated with said knob means for moving said capsule left and right, extending from respective sides of said pulley through said flexible connection means and connecting with a bulkhead portion of said capsule at respective positions left and right of a capsule vertical axis;

20

f. a third cable wrapping about said pulley within said control module associated with said knob means for moving said capsule up and down, extending from respective sides of said pulley through said flexible connection means and connecting with a bulkhead portion of said capsule at respective positions above and below a capsule horizontal axis;

25

- 5
- g. a fourth cable endlessly wrapping around said pulley within said control module associated with said knob means for opening and closing said capsule, extending from respective sides of said pulley through said flexible connection means and connecting with a pulley within said transition portion threadedly engaging a stationary shaft therein extending generally perpendicularly to a plane defined by juncture of said upper and lower shell portions;
- 10 h. said cables residing within said slots of said disk flanges within said tubular member and extending therethrough into said operating capsule;
- 15 i. said pulley within said transition portion traversing said shaft due to relative rotation therebetween and being connected to said shell upper portion to open and close said shell upper portion relative to said lower portion as said pulley moves respectively up and down said shaft; and
- 20 j. an endoscope slidably resident within said inner sheath and said operating capsule.
- 25 2. Apparatus for endolumenally removing undesired lumenal tissue and securing remaining lumenal tissue about the site of removal, comprising means for fastening together portions of lumenal tissue adjacent to undesired lumenal tissue to prevent

creation of an aperture in said lumen which would otherwise result upon removal of said undesired luminal tissue.

3. Apparatus of claim 2 further comprising means for detaching said undesired luminal tissue from said lumen.

5 4. Apparatus of claim 3 further comprising means for gripping luminal tissue proximate said undesired tissue and pulling said gripped tissue and said undesired tissue into a cutting zone removed from an undisturbed position of said luminal tissue.

10 5. Apparatus of claim 4 wherein said means for gripping luminal tissue proximate said undesired tissue and pulling said gripped tissue and said undesired tissue into a cutting zone removed from an undisturbed position of said luminal tissue further comprises means for gripping said luminal tissue at positions on two sides of said undesired tissue.

15 6. Apparatus for endolumenally removing a wall section of undesired luminal tissue and securing remaining luminal wall tissue from either side about the site of removal, comprising:

a. means for sequentially and simultaneously:

20 i. fastening together portions of luminal tissue which are adjacent to undesired luminal tissue to prevent creation of an aperture in said lumen which would otherwise be created upon removal of said undesired luminal tissue; and

25 ii. detaching said undesired luminal tissue from said lumen.

- RECEIVED
U.S. PATENT AND TRADEMARK OFFICE
JULY 1997
7. A method for endolumenally resectioning lumenal tissue by anastomosing the tissue with artificial fastening means, comprising:
- a. inserting a tissue suturing and cutting instrument into a body lumen through a naturally occurring body orifice;
 - b. advancing said instrument within said lumen to an area of undesired lumenal tissue to be resectioned;
 - c. drawing said undesired lumenal tissue into a cutting zone associated with said instrument;
 - d. stapling said surrounding lumenal tissue to close an orifice which would otherwise result from removal of said undesired lumenal tissue;
 - e. cutting said undesired lumenal tissue from surrounding lumenal tissue.
- 15 8. The method of claim 7 wherein said tissue drawing step further comprises drawing said undesired lumenal tissue into said instrument; and wherein said method further comprises:
- a. closing said instrument after said drawing step but prior to said stapling step.
- 20 9. The method of claim 7 wherein said tissue drawing step further comprises:
- a. grasping said lumenal wall interior on respective sides of said undesired lumenal tissue;
 - b. drawing said grasped lumenal wall sufficiently into a cutting zone that the lumenal wall folds against itself in the cutting zone;

and said stapling step further comprises:

- c. stapling said folded lumenal wall to retain the lumenal wall exterior in facing contact with itself;

and said cutting step further comprises:

- 5 d. cutting said folds of lumenal wall inboard of said position of stapling.

10. The method of claim 9 further comprising:

- a. retaining said cut undesired lumenal tissue within said instrument separated from said lumen; and

- 10 b. withdrawing said instrument along said lumen and from said body while retaining said cut undesired tissue within said instrument and separated from said lumen.

11. The method of claim 7 further comprising performing said stapling and cutting simultaneously.

15 12. The method of claim 11 wherein said simultaneous suturing and cutting is performed by moving a unitary suture advancer and tissue cutter along a predefined path transversely to direction of suture advancement.

13. The method of claim 12 wherein said path is at least partially straight.

20 14. The method of claim 12 wherein said path is at least partially curved.

15. The method of claim 12 wherein said path is of adjustably selectable length.

16. Apparatus for endolumenally resectioning diseased lumenal tissue and reanastomizing remaining lumenal tissue with fastening means, comprising;
- a. means for gripping lumenal tissue at axially on respective sides of said diseased tissue and pulling said gripped tissue and said diseased tissue surrounded thereby into a cutting zone removed from an undisturbed position of said lumenal tissue;
- b. means for detaching said diseased lumenal tissue from surrounding healthy lumenal tissues; and
- c. means for fastening healthy lumenal tissue together across an aperture therein created by detachment of said diseased lumenal tissue from said healthy lumenal tissue, to close said aperture.
17. The apparatus of claim 16 wherein said tissue fastening means further comprises:
- a. a plurality of staples;
- b. a movable ramp for serially driving individual ones of said staples through lumenal tissue portions to be fastened together.
18. Endolumenal surgical apparatus comprising:
- a. a longitudinally elongated lip;
- b. suturing means in said lip for passing through tissue positioned along said lip and thereby securing said tissue together;

5

c. suture advancement and tissue cutting means movable along said lip, for advancing said suturing means through said tissue thereby effectuating suturing securement of tissue and cutting said tissue inboard of said sutured securement.

10

19. Apparatus for advancing an endolumenal operating capsule along and within a body lumen by transmitting manually applied force thereto along a curvilinear path, connecting said capsule to an operator control module external of the body and transmitting control signals from said control module to said operating capsule, comprising:

15

- i. a pair of annularly spaced flexible tubular sheaths;
- ii. a plurality of serially engaging conical disks between said inner and outer sheaths, each disk comprising a plurality of radial apertures being adapted for residence of operating control signal transmission means therein, for transmitting axial force sequentially one to another as said apparatus bends to define said curvilinear path while limiting such curvilinear bending of said apparatus to a preselected degree;
- iii. longitudinally elongated sinuous means, extending the length of said apparatus and resident within the apertures of said disks, for transmitting said

20

25

control signals from said control module to said operating capsule.

20. Apparatus of claim 19 wherein each disk further comprises:

- a. a hollow central conical portion having an axial aperture at the center thereof, said inner sheath residing within said aperture;
 - i. an annular flange at the base of said conical portion;
 - ii. a convex conical exterior surface of said conical portion extending through said annular flange and fitting into the hollow central conical portion of an adjacent disk, in sliding complementary contact therewith;
 - iii. said flange having said plurality of slots therein extending radially inwardly from the flange periphery.

10
15
20
25

21. An openable endolumenal operating capsule comprising a pair of shell portions which when closed have respective facing lip portions spaced from one another;

- a. said lip portions extending around a portion of a curved end of said shell and along a longitudinally elongated portion of said capsule;
 - i. anvil means resident in one of said facing lip portions, extending along said curved and longitudinally elongated portions thereof;

5 ii. suturing staple means resident in said remaining lip portion along the curved and longitudinally elongated lip portions facing said anvil means, for passing through tissue positioned between said respective lips and curling back into said tissue portion between said respective lips away from said anvil means due to contact therewith, for securing said tissue together along a line between said suturing staple means and said anvil means;

10 iii. tissue cutting and suturing staple advancement means movable along said lip portion having said suturing staples resident therewithin, for sequentially advancing said staples serially against said anvil means in said opposing lip portion when said shell portions are closed and thereby effectuating suturing staple securement of tissue between said lip housing said suturing staple means and said lip housing said anvil means.

15 22. Apparatus for advancing an endolumenal operating capsule along and within a body lumen by transmitting manually applied force thereto along a curvilinear path, comprising a plurality of serially engaging members for transmitting axial force sequentially one to another as said apparatus bends to define said curvilinear path while limiting such curvilinear bending of said apparatus to a preselected degree.

23. Apparatus for intralumenally removing undesirable tissue from
a lumen wall, comprising:

a. an endolumenal operating capsule comprising:

- i. a lip extending along a longitudinally elongated portion of said capsule;
- ii. stapling means resident in said lip for passing through tissue layers positioned on said lip and thereby securing said tissue layers together;
- iii. staple advancement and tissue cutting means movable along said lip, for advancing said stapling means through said tissue thereby effectuating securement of said tissue and cutting said tissue layers inboard of said tissue securement;

b. tubular apparatus for positioning said capsule along and within said lumen by transmitting manually applied force thereto along a curvilinear path as said apparatus bends to define said curvilinear path while limiting such curvilinear bending of said apparatus to a preselected degree, connecting said capsule to an operator control module external of the body and transmitting control signals from said control module to said operating capsule, comprising:

- i. a pair of annularly spaced flexible tubular sheaths;
- ii. longitudinally elongated sinuous means, extending the length of said tubular apparatus between said

inner and outer sheaths, for transmitting said control signals from said control module to said operating capsule;

5 iii. means between said inner and outer sheaths for maintaining said longitudinally extending operating control signal transmission means in circumferentially spaced relation to one another and transmitting capsule positioning force along a curvilinear path as said apparatus bends to define said curvilinear path while limiting such curvilinear bending of said apparatus to a preselected degree;

- 10
- 15 c. an operator control module for converting operator tactile motions to signals controlling operation of said capsule for input to said control signal transmission means; and
- d. an endoscope slidably resident within said inner sheath and said operating capsule.

20 24. Apparatus for endolumenally removing a cylindrical wall section of undesired lumenal tissue and circumferentially securing remaining lumenal wall tissue from either side about the site of said cylindrical removal, comprising:

- 25 a. means for
- i. fastening together circular margins of lumenal tissue which are adjacent to said undesired cylindrical lumenal tissue to prevent creation of a

breach in said lumen which would otherwise be created upon removal of said undesired cylindrical luminal tissue; and

- 5 ii. cutting said undesired cylindrical luminal tissue from said lumen radially inboard of said fastened together circular margins.

25. Apparatus of claim 24 wherein said tissue fastening and cutting means fastens said tissue simultaneously around the entire 360 degrees of said circular margin.

10 26. Apparatus of claim 25 wherein said tissue fastening and cutting means cuts said tissue simultaneously around the entire 360 degrees of said circular margin.

15 27. Apparatus of claim 24 wherein said tissue fastening and cutting means cuts said tissue simultaneously around the entire 360 degrees of said circular margin.

28. Apparatus of claim 24 wherein said tissue fastening and cutting means is means for sequentially fastening and then cutting.

29. Apparatus of claim 24 wherein said fastening and cutting means includes means for stapling tissue together.

30. A method for endolumenally cylindrically resectioning luminal tissue comprising:

- 25 a. inserting a tissue suturing and cutting instrument into a body lumen through a naturally occurring body orifice;
- b. advancing said instrument within said lumen to an area of undesired luminal tissue to be cylindrically resectioned;

- c. drawing said undesired cylindrical lumenal tissue into an annular cutting zone associated with said instrument;
- d. stapling said surrounding lumenal tissue about annular margins of said cylindrical tissue to close an orifice which would otherwise result from removal of said undesired lumenal tissue;
- e. cutting said undesired cylindrical lumenal tissue from surrounding lumenal tissue.

31. The method of claim 30 further comprising retaining the cut undesired cylindrical lumenal tissue within said instrument while withdrawing the instrument from the lumen through the naturally occurring orifice to maintain the cut undesired cylindrical lumenal tissue separated from healthy lumenal wall tissue.

32. The method of claim 30 further comprising stapling said tissue simultaneously around the entire 360 degrees of said circular margin.

33. The method of claim 32 further comprising cutting said tissue simultaneously around the entire 360 degrees of said circular margin.

34. The method of claim 30 further comprising cutting said tissue simultaneously around the entire 360 degrees of said circular margin.

35. Apparatus for endolumenal tubular resection comprising:

- a. a continuous annular lip;

5

- b. suturing means in said lip for passing through tissue positioned around said lip and thereby securing said tissue together;
- c. suture advancement and tissue cutting means movable about said annular lip, for advancing said suturing means through said tissue thereby effectuating suturing securement of tissue entirely about the annular lip and cutting said tissue inboard of said sutured securement.

add air